Total quality control in selected Iowa manufacturing industries

by

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CHAPTER I. BACKGROUND

Introduction

There has always been a demand for quality in the product that customers purchase. In a general sense, this includes the feel, look, size, appearance, and any other characteristics that a manager determines as the model for the customer. It was not until the 1800s that more precise measuring devices were introduced into the manufacturing process.

During the American Revolutionary War, it became apparent that there was a need for interchangeable parts. This period brought about a need to develop precise measuring devices to ensure the accuracy of the parts of a product.

Many large businesses began using inspectors. Statistical quality control was originated by Walter Shewhart in 1926, and during World War II, which entailed the use of standard deviation and control charts. Simmons (1970) stated:

> "Again, under the impetus of war, a new phase was born about 1954. This was the quality system, complete with written descriptive procedures conforming to specification MIL-Q-5923 and its several sister documents. Generally, in an informal way, this new requirement forced a formal quality system on industry and introduced the new need for full-time engineering activities for quality. Thus emerged the quality engineer whose initial duties were to assure customer representatives that quality procedures were adequate, that they were being followed, and that corrective action was being taken when necessary.

> After a few years, the primary requirements of MIL-Q-5923 had been mastered by quality personnel, and quality engineers began to look for a new fields to conquer. In 1961, the concept of total quality control was first introduced by A. V. Feigenbaum in a book by that title and served to describe those areas where quality programs should be applied. This concept utilized a quality systems approach and emphasized planning and measuring methods to ensure product quality rather than increased inspection programs" (p. 9).

Today the demand for greater durability and reliability of products and services has intensified tremendously. Not only do consumers request the higher quality, but the price of the product or service must remain within an affordable range. The higher quality will keep customers returning time after time.

While quality of products and services have improved considerably, there is much more that remains to be done. Feigenbaum (1983) stated:

> "For every dollar spent in planned engineering, production, and product services, a great number of industries today are losing additional cents because of poor quality practices during engineering manufacturing or after a product is in the field. These conditions cannot be tolerated by any industry striving to maintain and improve its competitive position" (p. 5).
>
> He asserts that "the attainment and maintenance of satisfactory levels of customer satisfaction with the quality of products and services are today; fundamental determinants for business health, growth and economic viability" (Feigenbaum, 1983; p. 5).

The precarious financial situation of industries in 1987, has made it necessary for many manufacturing industries to implement

total quality control programs as a major business strategy as it contributes to business profitability. However, many manufacturing industries have not implemented total quality control programs. These companies are facing major problems such as poor quality, and survival in an extremely competitive market. If these industries are to survive and maintain a competitive position in the market, they must focus attention on developing quality improvement programs that will meet the increased demand for improved quality. The total quality control program should be the responsibility of everyone in the company from top management to hourly employees. Many companies have developed quality improvement techniques; some, however, are purported to be more thorough than others.

Statement of Problem

Today, the expectations of buyers--whether consumer or industrial corporations--have greatly intensified the demands upon management. This turbulent process has caused management to redefine their standards of operation. This should include managing to assure Total Quality Control or productivity, rather than only that of the blue collar worker.

It is evident that there is a need for improvement in the area of quality. The product must be acceptable at an affordable price. This can be achieved through Total Quality Control. In recent years, total quality control has produced improvements in the quality and reliability of products as well as reduced cost.

Most manufacturing industries employ some form of quality program, but do such programs have an organizationwide impact? This study is designed to investigate the type of quality programs and methods that Iowa manufacturing industries employ.

Statement of Purpose

This study is designed to investigate if quality programs in Iowa manufacturing industries have an organization wide impact, from top management to hourly employees.

Need for the Study

In recent years, there has been an increased need to improve quality in the manufacturing of products. This need has evolved from increased competition, consumer demands, safety legislation, etc. Programs must be implemented to meet these increased demands. The traditional inspection and test programs are not sufficient today to meet the increased demands.

> "Traditional control programs have been too limited in the face of some production processes that, in their present form and concept, simply will not produce designs that were created in overly narrow functional engineering terms and are just not sufficiently reliable in actual customer use; and in the face of product service programs that were developed in band-aid terms and cannot provide the necessary levels of product maintenance" (Feigenbaum, 1983; p. 13).

Feigenbaum (1983) further stated:

> "Truly effective total-quality- control programs enter deeply into the fundamental concept of such product designs, into the basic setup of

> such production processes, and into the scope of such product service because there is no other way to achieve the necessary levels of quality in today's market" (p. 13).
>
> "The need for such organizationwide impact is demonstrated in company after company throughout the world. Experience shows that as much as 80% and more of fundamental quality problems requiring improvement today are outside of the scope of traditional quality control departments. As few as 20 percent or less of important quality problems have tended to be dealt with effectively under these more traditional quality approaches" (Feigenbaum, 1983; p. 151).

The total quality control system has many advantages when implemented properly. The responsibility for quality is shared by everyone in the organization. When the need arises for the resolution of a problem, there is quick remedial action and the employees gain confidence as the quality system progresses.

Questions of the Study

1. To what extent does top management participate in the implementation of quality improvement programs?
2. What predominant methods are used to determine the quality problems that exist and the corrective action to resolve these problems?
3. What particular methods or procedures are used to evaluate and maintain product conformance?

4. Are specific programs setup to train and inform supervisors and employees of their responsibilities in the quality improvement program?
5. What evaluations or procedures are used most frequently to determine the overall performance of the quality improvement system?

Assumptions of the Study

The following assumptions were made in order to conduct the study:

1. Iowa industries will provide information on the type of quality systems implemented in their facilities.
2. Iowa industries employ some form of quality control programs.
3. Quality in Iowa industries can be measured.
4. Quality-related problems do not originate with the workers in the manufacturing areas.
5. The quality department is only responsible for measuring product conformance, clearly reporting the results, and they should strive to develop a positive attitude toward quality improvement.

Delimitations of the Study

The following delimitations have been identified:

1. The study will represent manufacturing industries (fabricated metals; machinery, and transportation equipment) in the state

of Iowa. The sample for this study is made up of representatives from Iowa manufacturing industries that employ two hundred fifty (101) or more. Therefore, findings generalizability is affected, results are only representative of the midwest or similar areas and cannot be used as indicative of those industries in other regions of the country.

2. The questionnaire used for data collection in this study is based on the respondent's responses and the adequacy of the information requested.

Definition of Terms

1. Control- A process for delegating responsibility and authority for a management activity while retaining the means of assuring satisfactory results.

2. Cost of quality- The periodic collection and analysis of quality costs monitors the cost effectiveness of the quality system.

3. Organizationwide impact of total quality control- Total quality control's organizationwide impact involves the managerial and technical implementation of customer-oriented quality activities as a prime responsibility of general management and of the main-line operations of marketing, engineering, production, industrial relations, and service as well as of the quality control function itself.

4. Quality- The total composite product and service characteristic of marketing, engineering, manufacture and

maintenance through which the product and service in use meet the expectations of the customers.

5. Quality system- The agreed upon, companywide and plant wide operating work structure, documented in effective, integrated technical and managerial procedures, for guiding the coordinated actions of the people, the machines, and the information of the company and plant in the best and most pratical ways to assure customer quality satisfaction and economical costs of quality.

6. Total quality control- An effective system for integrating the quality development, quality maintenance, and quality improvement efforts of the various groups in an organization so as to enable marketing, engineering, production and service at the most economical levels which allows for full customer satisfaction.

CHAPTER II. REVIEW OF LITERATURE

History of Quality Control

Prior to the Industrial Revolution, quality-oriented tasks were performed by inspectors and testers. Following the Industrial Revolution, the factories became the largest productive units. These factories were organized into machine shops. Each machine shop was supervised by a foreman and each shop foreman required the use of full time inspectors.

With the rise of the Taylor system of scientific management, the responsibilities of the shop foreman were narrowed. The foreman's responsibility was to execute plans and meeting production requirements. The Taylor system placed stress on the productivity of the workers. At this point quality of the product was jeopardized because shop inspectors were subordinates of the shop foreman. The foremen first priority was to increase the level of production. This weakness in the organization became apparent during World War I when much unfit product was delivered to customers.

During the 1930s, there were discussions to derive a means to prevent defects from occurring from the outset. These discussions were accelerated during World War II when many manufacturing companies had difficulties and delays in making defense products fit for use. These companies experienced many quality problems whenever there was a changeover to defense products. Upper managers decided that to attain the desired level of quality there must be a systematic approach to quality planning and to defect prevention.

During this period, W. A. Shewhart of Bell Laboratories originated the use of statistical quality control (SQC). This involved the use of control charts through statistical methods to determine how the process was performing.

During the 1940s, the War Production conducted courses on statistical quality control for industrial companies. These courses contributed to the formation of the American Society of Quality Control (ASQC). Many of the companies that attempted to apply the statistical techniques to their quality problems suffered a setback due to uneconomic application of the techniques. As a result of this setback, the job title of quality control engineer emerged. The quality control engineer began to implement these statistical techniques.

As computers and military systems advanced during the 1950s, many field failures became evident. It was that the cause of these failures originated in the product development and design phases rather than during manufacturing. To overcome this problem a new position emerged, known as the reliability engineers. Their responsibilities were to review the design process as well as testing the product before it is shipped to the customers (Gryna & Juran, 1980).

Gryna and Juran (1980) indicated, "the 1960's witnessed an extensive growth of product legislation, liability suits, consumerism, and related phenomena. Collectively, these stimulated a growth in the use of forms of quality assurance, notably independent audits" (p. 561). This was a department separated from the quality

control department. Juran (1979) defines quality assurance as " the activity of providing to all concerned, the evidence needed to establish confidence that the quality function is being performed adequately " (pp. 2-23).

During the 1970s and 1980s, because of increased competition and expectation of customers, there is a new spectrum of management problems. Fiegenbaum (1983) stated, "in a turbulent process which amounts to redefining standards of living in terms acceptable to all of us in our dual roles as customers and producers. Debates about pollution and economic growth and consumerism and energy and worker participation and team manufacturing are leading to changes in our industrial concepts so massive that some people have begun to say the changes constitute a second Industrial Revolution" (p. 3). Managing to assure total quality control is evident today if companies are to remain competitive.

Current Total Quality Control Programs

Today the pace of new technology is increasing at a rapid pace for products and services. In order for manufacturing industries to remain competitive and profitable, there must be new developments in operational technology as well. Top management at these companies must develop and monitor the systems to effectively meet these new demands.

With much emphasis placed on the quality of products, there must be systems implemented that will yield a quality product at an affordable price in order to satisfy customer needs. To accomplish

this task, everyone in the manufacturing organization must be involved in the improvement process.

There are several well-known quality experts in the field who have developed procedures or principles that integrates everyone in the organization into the quality improvement program. Each of these experts agree that top management must establish the system on a basis that is intensive enough to ensure that it will produce the intended results during operation. This portion of the review of literature will be divided into five sections: 1) A. V. Feigenbaum total-quality-control system; 2) Dr. Edward Deming's fourteen (14) management principles; 3) Phillip Crosby's fourteen (14) step program; 4) Total Quality Control: The Japanese Way; 5) Joseph M. Juran Views on Quality Improvement.

A. V. Feigenbaum Total-Quality-System

Feigenbaum (1983) system for total quality control began by identifying the customers quality requirements and ended when the product is placed in the hands of the customers who remained satisfied. The total quality system provides integration and continuous control to all key areas. Feigenbaum (1983) stated "Thorough analysis of the root causes of quality problems have usually shown that these problems exist in many, rather than a few areas of the product" (p. 81).

Feigenbaum's (1983) idea of total quality control used a systems engineering and systems management approach. Top management was responsible for and committed to communicating the quality system to

all members of the organization. Even though top management was responsible for structuring and delegating responsibilities of the system, they still relied on the quality department for establishing the operating procedures for the quality system. Systems Engineering continually worked to update the quality system by providing the most up-to-date quality technology.

Systems engineering and systems management activities for total quality control Feigenbaum (1983) stated, "for the achievement of total quality systems it is now a center point of effective quality engineering and quality management directed to the development and on-going leadership of a strong, integrated-rather than fragmented-quality system which operates with economy, efficiency, and enthusiastic support throughout the entire company and plantwide organization" (p. 84). The key system activities must provide for evaluation of quality, quality cost, and quality activities.

He defined these key activities as follows:

1. Systems engineering is the technological process of creating and structuring effective people-machine-information quality systems.

2. Systems management is the administrative process of assuring effective operation of the quality system.

3. Systems economics, especially including quality cost, is the measurement and control process for guiding the most effective resource allocation of the people-machine-information content of the quality system.

4. Systems measurement, particularly with respect to systems

audits and customer quality determined, are the process of the evalution of the effectiveness with which the quality system meets its objectives and fulfills its goals (Feigenbaum, 1983, pp. 84-85).

These key activities are needed to establish the foundation for an effective total quality control system. There are several subsystems that are important for a total quality control system which will be discussed in the following section.

Key subsystems for total quality control The subsystems will illustrate the contribution made to each of the system activities. The subsystem activities will explain how each individual within the company will be involved in the total quality control program and their responsibilities.

1. New design control

Once a new product is introduced, it is an opportunity to gain marketshare for the company. There must be programs established to evaluate each phase of the design process prior to the start of production. If not, these companies will be faced with problems such as an increase in expenses as well as poor quality.

Feigenbaum (1983) states, "for the new-design control activities of a company to be fully effective, a definite routine for it must be established and maintained within the framework of the quality system" (p. 623). Feigenbaum (1983) developed a step by step routine to be used during the design of a product. The design phase should involve input from several departments such as Marketing, Production Control, Purchasing, Quality Control, Manufacturing, etc., to compile the

necessary information throughout the design process. By including input from the various departments in the planning, preliminary, prototypes, testing, and initial startup phases, it reduces the number of problems after production has begun and the quality level is better.

2. Product and process quality planning

Feigenbaum (1983) indicated at this phase, it is when the plans are established as to how the product being designed will be measured and controlled. This includes the process to be used to manufacture the product as well as the type of devices that will be used to measure the desired characteristics. Quality control personnel should receive training for the new procedures such as sampling techniques, recording data, etc.

3. Purchased-material quality planning, evaluation, and control

Once the new design is developed, it should be the responsibility of the purchasing department to see that the materials and/or subassemblies used to manufacture the product are of the proper quality. Too often in the past companies have trusted vendors to ship a quality product or the company would spend a great deal of time and money inspecting the incoming material which can present a hazard, whether it be safety related or economics (Feigenbaum, 1983).

Feigenbaum (1983) stated "three aspects in which incoming-material practices of many companies have been unsatisfactory in assisting plant management to achieve its quality-product goal: First, these incoming material procedures have too often permitted nonconforming

materials to be accepted by the plant for use on its production lines. The second aspect in which these incoming material practices have been inadequate is more directly related to economics. The third aspect in which companies' incoming-material control practices have been unsatisfactory has been the lack of clearly established relationships between the vendor and the purchaser with regard to quality" (pp. 679-680).

The purchasing department of the company must develop and implement guidelines for incoming product quality that is clear to both the vendors and the purchasing organization. There must be a close working relationship maintained at all times between purchasing and the vendor. The companies quality requirements must be clearly established and communicated to the vendor. When this happens, it will benefit the company as well as the vendor.

4. Product and process-quality evaluation and control

Feigenbaum (1983) indicates, this component is the implementation of the plan established in part 2. In other words, this component controls the quality throughout the production process. With the modern and complex processes which produce the product at faster rates of speed, there must be sufficient in-process control techniques to predict process trends. Such techniques as statistical process control (SPC) and process capacity studies along with several other control techniques are mentioned by Feigenbaum. These techniques allow the operators to make the product right the first time.

5. Quality information feedback

This component by Feigenbaum (1983) establishes procedures for communicating problems as well as solutions to improve the system to each department. He states three primary aspects of quality information feedback: 1) identification of the explicit information; 2) establishment of information flow; and 3) integration of quality information.

The three aspects of quality information feedback by Feigenbaum should first establish the needs of the user, which should be each department in the organization. Second, procedures should be developed to clearly communicate the quality information. Third, whenever needed the quality flow procedures should be evaluated to determine the effectiveness.

6. Quality information equipment

For this component, Feigenbaum (1983) discusses the importance of continually investigating the long-range needs with respect to measuring equipment. For example, as new designs and processes are being developed or updated, the equipment to be used to measure the characteristics should be investigated as well to determine if they are adequate. This component is essential, especially with the demands to produce a quality product. If the company is to produce a quality product, there must be precision equipment for maintaining proper tolerances.

7. Quality training, orientation, and work force development

If the quality system is to function properly, the individuals who will operate the quality should receive the proper training. This includes everyone directly and indirectly related to the quality program.

8. Postproduction quality service

For this component, Feigenbaum (1983) indicated that even when the product is performing for the customer, there is the possibility the product will fail prior to its expected life. This creates complaints and unsatisfied customers. Procedures should be established to handle these complaints and/or the corrective action. When necessary, there should be procedures to service the product periodically. He further states that the information should be communicated to marketing, manufacturing, and engineering.

9. Special quality studies

This component by Feigenbaum (1983) establishes procedures to identify quality problems, as well as solutions to these problems. There should be ongoing analysis of all phases of the system for improvement on a continuous basis.

10. Key areas of systems measurement

The final component by Feigenbaum (1983) is the systems measurement activity. This component is established as feedback to management on how the system is performing. He mentions the four key areas: 1) measurement of cost, 2) measurement of quality, 3) measurement of customer satisfaction, and 4) measurement of system

conformance.

Dr. W. Edward Deming 14 Management Principles

Dr. Deming's (1982) 14 principles for management are used to achieve quality and productivity in this competitive environment. His methods, which are used by some companies, incorporate the use of statistical methods. These methods are only effective if management is committed to changing its thinking and behavior.

Dr. Deming's (1982) principles stress the fact that the improvement of quality is a never-ending process. Management must take the responsibility for establishing a long-term quality improvement system. Due to the fact that most employees resist change, top and middle managers must demonstrate their position and attitude in order to create the foundation for quality improvement and excellence. This will remove the barriers of fear and mistrust, which facilitate the altering of employees' views.

Dr. Deming (1982) further emphasized that companies must move from defect detection (inspection) to defect prevention. He expresses the importance of a close relationship between vendors and buyers. "Statistical methods provide the means to measure, monitor, and improve quality in the extended process. Working with vendors to improve their processes necessitates the use of statistics as a common language within a long-term single-source relationship" (Deming, 1982; p. 42).

Management must continually search for methods to improve the system through brainstorming, parts analysis, check sheets, flow charts, the fishbone diagram, control charts, etc. The supervisors as

well as the employees must be trained to use these new methods. This will enhance their performance and create a positive attitude among workers.

Initial steps must be taken to create a secure and fearless environment for all workers. When there is two-way communication between supervisors and workers as well as between departments, the morale and productivity of each employee increases. The employees feel comfortable with discussing problems and contribute to improving quality. This creates a concept of teamwork and trust among employees.

Deming (1982) indicated that numerical goals, slogans, and work standards should be eliminated. These goals should be replaced with statistical methods. Once these methods are implemented properly, it allows everyone to see exactly what exists. Dr. Deming (1982) sees work standards as a "fortress against improvement of quality and productivity." Gitlow and Gitlow (1987) stated, "supervisory relationships are hampered because of employees' fear of not reaching quotas, and barriers are created between managers, supervisors, employees, and unions because standards don't encourage meaningful communication. If employees can be supervised and trained using control charts as a common ground for communication, fear and barriers would diminish, the quality of work would improve, and there would be no need for quotas" (p. 368).

Gitlow and Gitlow (1987) further stated, "managing for failure, accepting poor quality as a way of life, and handicapping employees

with problems in the system--all rob workers of their right to pride of workmanship. Removal of the impediments of the system by management creates an atmosphere in which productivity and quality can improve and employees can feel proud of their work. Management must provide workers with defect-free materials, must use statistical methods to analyze and act on causes of variation, and must provide proper supervision and training to do this" (p. 175).

Deming (1982) further indicated that workers must be retrained as new methods and technology become available. This indicates to employees that top management is totally committed to long-term quality improvement.

Philip Crosby 14-Step Quality Improvement Program

Crosby (1979) developed this quality improvement program as a quality manager at ITT. In the early stages, the foundation for Crosby's quality improvement program was the development of four legs: 1) management participation and attitude, 2) professional quality management, 3) original programs, and 4) recognition.

From these four legs, Crosby (1979) developed the Management Maturity Grid. This grid consists of five states with six management categories. By referencing the grid, any manager can pinpoint the stage of their quality program at that moment. Once the managers locate their position on the grid, the remaining steps can be used as a format to continue to develop their quality improvement program. Crosby (1979) 14-step quality improvement program which began at stage III on the Management Maturity Grid is listed below:

1) Management Commitment

2) Quality Improvement Team

3) Quality Measurement

4) Cost of Quality Evaluation

5) Quality Awareness

6) Corrective Action

7) Establish an Ad Hoc Committee for the Zero Defects Program

8) Supervisor Training

9) Zero Defects Day

10) Goal Setting

11) Error Cause Removal

12) Recognition

13) Quality Councils

14) Do it Over Again (Crosby, 1979, pp. 132-139)

Crosby (1979), like Feigenbaum indicated that top management must be personally committed to quality improvement. Everyone in the organization should be involved in the quality improvement program.

Crosby's (1979) quality improvement program is primarily based on a team concept. The team consists of members from each department, with one of the members appointed as chairman. The team members will represent their respective departments as well as implementing any programs established by the quality improvement team in their department. The quality improvement team is responsible for establishing programs and procedures to implement the steps in the quality improvement program as well as taking action if the programs

established are not being executed in the departments. Crosby (1979) indicated that all levels of management should be formally oriented to the procedures prior to implementation of each step. The program should include procedures for manufacturing areas as well as the nonmanufacturing. The comptroller should be responsible for establishing the cost of quality. The quality department and the team chairperson should meet regularly to determine the action needed to upgrade and improve the system.

Crosby (1979) further indicated that this 14 step quality improvement approach takes approximately one year to eighteen months to implement. There will be improvement in quality as each step is implemented. He indicates that the last four steps are for setting goals to continue to improve the program.

Total Quality Control: The Japanese Way

During the early 1950s, Dr. Edward Deming was invited to Japan to conduct seminars on statistical quality control. Even though Japan was introduced to statistical quality control in the late 1940s by the U.S. occupation forces, they encountered problems in adapting the American methods to Japan. Dr. Deming taught statistical methods, such as sampling techniques and the uses of control charts as well as emphasing to top management the importance of quality control.

In 1959, Dr. Juran was invited to Japan to conduct seminars for middle and upper level managers. These seminars continued to emphasize the roles of management in the promotion of quality control. The techniques of Dr. Deming and Juran were used by Japan to establish

company-wide quality control.

According to Ishikawa (1985), Japan's total quality control differs somewhat from Fiegenbaum total quality control program. Ishikawa (1985) stated "our approach has always been to educate everyone in every division and to let each person implement and promote quality control. Our quality control courses are now well defined, and separate courses are available for different divisions" (p. 90).

In an article by Lawrence P. Sullivan (1986), the seven stages of company-wide quality control were outlined and discussed in detail. Sullivan indicated that Ishikawa defines company-wide quality control as a means "to provide good and low cost products, dividing the benefit among consumers, employers, and stockholders while improving the quality of people's lines "(Sullivan, 1986, p. 77). Let's look briefly at the seven stages identified by Sullivan.

Stage 1. Inspection after production (product-oriented)

Sullivan (1986) stated "inspection after production is the traditional form of quality control. In Japanese companies, top management audits the system rather than the product to put emphasis on changing the system for quality improvement" (p. 78). In other words, we should not wait until the product is finished to inspect for defects, there should be a system implemented that will prevent defects. The systems are implemented in every department within the organization. Management in Japanese companies feel that many problems can be prevented during product development and design

stages.

Stage 2. Quality control during production (process oriented).

At this stage, many Japanese companies have implemented SPC to control as well as improve the process, Sullivan (1986) indicated, SPC is a method, if used properly "reduces variability by improving the process capability which is reflected in change taking place in control limits (wide to narrow)" (p. 80).

Stage 3. Quality assurance involving all departments (systems oriented).

According to Sullivan (1986), "Ishikawa has pointed out that U.S. companies are typically very strong vertically and somewhat weak horizontally. This characteristic effectively prevents the natural development of company-wide quality control" (p. 80). Japanese companies are strong vertically as well as horizontally. This means that the staff departments are strongly involved in the quality control activities.

The three stages above are referred to by Japan as the quality control aspect of company-wide quality control or what the U.S. call total quality control. Sullivan (1986) stated, "many U.S. companies have demonstrated considerable quality improvement in recent years through the use of total quality control. Many U.S.-made products simply cannot compete in cost with Japanese imports. The remaining stages in company-wide quality control have contributed greatly to Japanese quality but they also have played a significant role in reducing cost" (p. 81).

Stage 4. Education and training (humanistic aspect of quality).

Even after a formal education, the Japanese feel that continuous training improves the worker's skills. In a recent study mission to Japan, Sullivan (1986) indicated that Manao Nemoto, the president of Toyota Gosei stated that "in Japan, personal capability is more important than process capability, and the main job of management is to improve the personal capability of all employees through education and training" (p. 81).

Another important aspect of this stage reported by Sullivan (1986) is job rotation by managers and executives, which broadened the knowledge of everyone. Because of this flexibility, they can operate efficiently.

Stage 5. Product and Process design optimization for more robust function (society oriented).

Sullivan (1986) indicated that the Japanese have used the methods by Genichi Taguchi to optimize the design process. Their idea is to avoid any loss to society as a result of quality. Sullivan (1986) stated, "quality is infused into all aspects of a product's life and an inherent philosophy that is integrated throughout the entire corporate structure" (p. 82).

Stage 6. The Taguchi loss function (cost oriented).

Another aspect of Taguchi methods is the quality loss function. Taguchi developed a formula for companies to determine what their loss will be. In Sullivan's (1986) report it is stated that the loss function is built on a definition of quality as "uninformity

around a target value. Because we are interested in the overall loss caused by a product and that loss becomes greater the more the product deviates from the target value-regardless of whether it is within spec." (p. 83)

Stage 7. Quality function deployment to define the "voice of the customer" in operational terms (consumer oriented).

This is a way to translate the customer's requirements into a technical language. Sullivan (1986) indicated that there are tables to trace the way quality function deployment (QFD) is implemented. He further stated "what is important is to incorporate QFD activities as a part of company-wide quality control activities and carry them out systematically and continually as routine functions.

Joseph M. Juran View on Quality Improvement

Juran (1986) developed the quality trilogy. He stated, "the underlying concept of the quality trilogy is that managing for quality consists of three basic quality-oriented process: Quality planning, 2) Quality control, and 3) Quality improvement" (p. 20).

Juran (1986) indicated that quality planning should be a function of top management. The goals and objectives for quality should be established. For quality control, it must be determined what needs to be controlled and how to control it. To improve the process, first the cause must be found, after which a remedy is provided.

Juran (1979) discussed his ideas and procedures in-depth in the book entitled Quality Control Handbooks for which he is the editor-in-chief. A major advantage of Juran's book is that he not only

discusses how to improve quality, but he has developed guidelines for many different areas in both manufacturing as well as service.

Summary

Traditional quality control programs are narrow and the responsibilities are that of the quality control department. Quality is a system approach to assure that the customer will receive a reliable product. The customer considers the quality of the product against the price before making the decision to purchase. Another factor the customer must take into consideration is the quality of service; that is the warranty, periodic checks, and money back guarantees.

On the other hand a company is in business to serve customers, therefore their standards must be customer-oriented. Too often, quality programs are limited to the elimination of customer rejects or returns for defective products.

The quality improvement programs outlined above were developed by experts in the field of quality. Even though some companies have implemented portions of these programs, there is still a great deal of work that needs to be accomplished for companies to produce a quality product at a reduced cost. As stated by each of these experts, in order to launch a total quality improvement program, top management must be totally committed to quality improvement. Total quality improvement is a never-ending process, when implemented properly it helps to establish a successful company.

The review of the literature provided several insights into the

current research efforts. Historical perspective, variables to be considered, and analysis of previous research results cited all helped in the formulation of the design and procedures for carrying out this research.

CHAPTER III. METHODS OF PROCEDURES

This chapter describes the characteristics of the population and sample, instrument development, data collection procedures, and concludes with a description of the analyses used. The methods and procedures for this study will include the following research sections.

Definition of Population and Identification of Sample

The population for this study consisted of manufacturing industries that produce fabricated metal products, machinery (electrical and nonelectrical), and transportation equipment. The population of manufacturing industries was limited to the state of Iowa.

A list of the manufacturing companies (fabricated metals, machinery, and transportation equipment) were obtained from the Directory of Iowa Manufacturing. From the list, a 20% proportional stratified random sample of companies was selected. The sample included companies that employed 101 employees and above. To determine the sample, the following formula was used, after which 15% was added because of nonreturns.

$$n = \frac{sp}{w}^2 = \frac{1.15(1.96)}{.3}^2 = 56 .$$

Instrument Development

The instrument used for this study was designed to obtain information concerning the type of quality programs and methods Iowa manufacturing industries employ. The instrument includes 45 items. The majority of items are stated in the Likert format with five response categories. Some were write-in responses and the remaining items presented one to six optional categories from which the respondents were to choose. These items included the position and responsibility of top management, the design department, purchasing, and manufacturing.

The instrument was pilot tested to ensure content clarity and reliability. Participants in the pilot test included twelve manufacturing companies in the state of Iowa. The participants were asked to complete the questionnaire for appropriateness.

Reliability

Cronbach's Alpha test of reliability was used to measure internal consistency. This analysis was performed on five subsections and then collectively on the questionnaires returned from the pilot test. The reliability for the subsections ranged from .73 to .91. The overall reliability was .94. Upon completion of the pilot test and reliability analysis, participants comments were taken into consideration after review of the initial draft of the questionnaire with the major professor and then it was printed in final form. A second test of reliability performed on the return questionnaires indicated an overall reliability of .95.

Data Collection Procedure

The cover letter and questionnaire were approved by the Human Subjects Committee of Iowa State University. (See Appendix A for questionnaire.) After approval, the questionnaires were mailed to sixty-five (65) Plant Managers, enclosed with self-addressed envelopes for returning the completed questionnaire. A cover letter was also mailed assuring confidentiality of all reported information. This letter was signed by the investigator and the major professor.

The instruments were coded to identify the Plant Managers that did not respond within two weeks. After two weeks, a follow-up letter was mailed as a reminder. Three weeks after the follow-up letters were mailed it was decided to cease data collection. A total of 37 (57%) usable returns were available for coding and data analysis. Of the 65 questionnaires mailed, two (2) were returned because of no forwarding address.

Data Analysis Procedure

The data were analyzed using the Statistical Package for the Social Sciences (SPSSX) (Nie, 1983). A program was written for the purpose of analysis, after which the data were coded by the researcher and entered into the computer with the assistance of personnel in the keypunch office at Iowa State University.

The program utilized frequencies to produce a table of frequency counts and percentages. Means and standard deviations were also obtained for purposes of interpretation and reporting of results.

CHAPTER IV. FINDINGS

This chapter contains results of the analysis of data collected for the study. The primary purpose of this study was to investigate if quality programs in Iowa manufacturing industries have an organization wide impact. Findings relative to the purpose are divided into four main sections; 1) Top Management, 2) Design, 3) Purchasing, and 4) Manufacturing.

Top Management

Table 1 illustrates whether top management established the procedures for reporting quality cost. Of the 37 companies responding, 37.8% strongly agreed that top management established procedures for reporting quality cost, while 21.6% agreed and 27% were neutral. As reflected in Table 2, 32.4% of the respondents indicated that management establishes quality cost reduction programs, 24.3% agreed and 29.7% were neutral.

As indicated in Table 3, 32.4% of the respondents disagreed or remained neutral that top management establishes a system for measuring the outgoing quality level, while 67.5% either agreed or strongly agreed. When asked whether top management established quality improvement goals and programs, 48.6% disagreed or remained neutral, while 51.3% agreed or strongly agreed as reflected in Table 4.

An examination of the data in Table 5 revealed that 21.5% either strongly disagreed or disagreed that top management establish

Table 1. Top Management Establish Procedures for Reporting Quality Cost

Reporting Quality Cost	Frequency	Percent
Strongly Disagree	1	2.7
Disagree	4	10.8
Neutral	10	27.0
Agree	8	21.6
Strongly Agree	14	37.8
Total	37	100.0
Mean 3.811		
S.D. 1.151		

Table 2. Top Management Establish Quality Cost Reduction Programs

Quality Cost Reduction Programs	Frequency	Percent
Strongly Disagree	1	2.7
Disagree	4	10.8
Neutral	11	29.7
Agree	9	24.3
Strongly Agree	12	32.4
Total	37	100.0
Mean 3.730		
S.D. 1.122		

Table 3. Top Management Establish Systems for Measuring the Outgoing Quality Level

Outgoing Quality Level	Frequency	Percent
Strongly Disagree	0	0
Disagree	6	16.2
Neutral	6	16.2
Agree	12	32.4
Strongly Agree	13	35.1
Total	37	100.0
Mean 3.865		
S.D. 1.084		

Table 4. Top Management Establish Quality Improvement Goals and Programs

Quality Improvement Goals	Frequency	Percent
Strongly Disagree	1	2.7
Disagree	8	21.6
Neutral	9	24.3
Agree	7	18.9
Strongly Agree	12	32.4
Total	37	100.0
Mean 3.568		
S.D. 1.237		

Table 5. Top Management Establish Procedures to Integrate All Individuals in the Quality Control Organization

Integrate Employees	Frequency	Percent
Strongly Disagree	3	8.1
Disagree	5	13.5
Neutral	13	35.1
Agree	4	10.8
Strongly Agree	12	32.4
Total	37	100.0
Mean 3.459		
S.D. 1.304		

procedures to integrate all individuals in the quality control organization, while 35.1% were neutral and 43.2% agreed or strongly agreed. In Table 6, respondents were asked whether top management establish measures to determine the contribution of the quality function to the profitability of the company. A combined 32.4% either strongly disagreed or disagreed that managment established measures to determine the contribution of the quality function to profitability, while 21.6% remained neutral and 43.2% agreed or strongly agreed.

Design

Table 7 reflects the extent that quality research is performed to determine customer requirements. While 29.7% strongly disagreed or disagreed, more than half (56.7%) either agreed or strongly agreed. More than 45% of the respondents reporting strongly disagreed or disagreed that a checklist is used to review each phase of the design process, while 16.2% remained neutral and 37.8% agreed or strongly agreed as indicated in Table 8.

When the respondents were asked whether their company used formal/informal meetings to review product and design specifications with the quality department and manufacturing engineering, 32.4% either strongly disagreed or disagreed, while 13.5% were neutral and more than half (54%) agreed or strongly agreed as reported in Table 9.

As indicated in Table 10, almost fifty percent (48.6%) strongly disagreed or disagreed that a tolerance analysis is performed on all new devices before they are placed in production at their company. While 16.2% were neutral, 35.1% agreed or strongly agreed. In Table

Table 6. Top Management Establish Measures to Determine the Contribution of the Quality Function to the Profitability of the Company

Measures for Profitability	Frequency	Percent
Strongly Disagree	3	8.1
Disagree	9	24.3
Neutral	8	21.6
Agree	8	21.6
Strongly Agree	9	24.3
Total	37	100.0
Mean 3.297		
S.D. 1.309		

Table 7. Quality Research is Performed to Determine Customer Requirements

Quality Research	Frequency	Percent
Strongly Disagree	3	8.1
Disagree	8	21.6
Neutral	5	13.5
Agree	8	21.6
Strongly Agree	13	35.1
Total	37	100.0
Mean 3.541		
S.D. 1.386		

Table 8. A Checklist is Used to Review Each Phase of the Design Process

Review of Design Process	Frequency	Percent
Strongly Disagree	7	18.9
Disagree	10	27.0
Neutral	6	16.2
Agree	9	24.3
Strongly Agree	5	13.5
Total	37	100.0
Mean 2.865		
S.D. 1.357		

Table 9. There are Formal/Informal Meetings to Review Product and Design Specification with the Quality Department and Manufacturing Engineering

Meeting Periodically	Frequency	Percent
Strongly Disagree	4	10.8
Disagree	8	21.6
Neutral	5	13.5
Agree	7	18.9
Strongly Agree	13	35.1
Total	37	100.0
Mean 3.459		
S.D. 1.445		

Table 10. A Tolerance Analysis is Performed on All New Devices Before They are Placed in Production

Tolerance Analysis	Frequency	Percent
Strongly Disagree	8	21.6
Disagree	10	27.0
Neutral	6	16.2
Agree	3	8.1
Strongly Agree	10	27.0
Total	37	100.0
Mean 2.919		
S.D. 1.534		

Table 11. Reliability Studies are Performed to Determine What Performance Can be Guaranteed

Perform Reliability Studies	Frequency	Percent
Strongly Disagree	5	13.5
Disagree	9	24.3
Neutral	4	10.8
Agree	7	18.9
Strongly Agree	12	32.4
Total	37	100.0
Mean 3.324		
S.D. 1.492		

11, respondents were asked whether reliability studies are performed to determine what performance can be guaranteed. Of the respondents reporting, 37.8% strongly disagreed or disagreed that reliability studies are performed, while 10.8% were neutral and more than half (51.3%) agreed or strongly agreed.

As reflected in Table 12, 27.8% strongly disagreed or disagreed that their design department participates in the selection of vendors for raw materials, while 22.2% were neutral and 50% agreed or strongly agreed. Fifty percent (50%) of the respondents strongly disagreed or disagreed that their design department establish the type of inspection required during production, while 33.3% were neutral and only 16.6% agreed or strongly agreed as reflected in Table 13.

When asked which areas does the design department become involved with, the results are indicated in Table 14. More than half (56.5%) of the respondents indicated that their design department assists in working out new methods and determining the desired tooling to be used for production, while there is no assistance from the design department in 43.5% of the companies surveyed. Also, 39.1% of the respondents indicated that the design department assists in determining the desired equipment for production, while in 60.9% of the companies' respondents indicated there is no assistance from the design department.

Purchasing

In Table 15, respondents were asked if in-coming raw materials are always at the highest quality level expected? Of the respondents

Table 12. The Design Department Participates in the Selection of Vendors for Raw Materials

Selection of Vendors	Frequency	Percent	Adjusted Percent[a]
Strongly Disagree	5	13.5	13.9
Disagree	5	13.5	13.9
Neutral	8	21.6	22.2
Agree	7	18.9	19.4
Strongly Agree	11	29.7	30.6
No Response	1	2.7	--
Total	37	100.0	100.0
Mean 3.389			
S.D. 1.420			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 13. The Design Department Establishes the Type of Inspection Required During Actual Production

Type of Inspection	Frequency	Percent	Adjusted Percent[a]
Strongly Disagree	11	29.7	30.6
Disagree	7	18.9	19.4
Neutral	12	32.4	33.3
Agree	3	8.1	8.3
Strongly Agree	3	8.1	8.3
No Response	1	2.7	—
Total	37	100.0	100.0
Mean 3.389			
S.D. 1.420			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 14. Which of the Following Does the Design Department Become Involved With

Participation by Design	Frequency	Percent	Adjusted Percent[a]
Working out any new methods			
Yes	13	35.1	56.5
No	10	27.0	43.5
Not Specified	14	37.8	--
Total	37	100.0	100.0
Mean 1.435 S.D. .507			
Determining the desired tooling for production			
Yes	13	35.1	56.5
No	10	27.0	43.5
Not Specified	14	37.8	--
Total	37	100.0	100.0
Mean 1.435 S.D. .507			
Determining the desired equipment			
Yes	9	24.3	39.1
No	14	37.8	60.9
Not Specified	14	37.8	--
Total	37	100.0	100.0
Mean 1.609 S.D. .499			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 15. In-coming Material are Always at the Highest Quality Level Expected?

In-coming Material	Frequency	Percent
Strongly Disagree	4	10.8
Disagree	10	27.0
Neutral	8	21.6
Agree	6	16.2
Strongly Agree	9	24.3
Total	37	100.0
Mean 3.162		
S.D. 1.365		

Table 16. The Vendors are Provided with Adequate Data on Quality Requirements by the Purchaser

Adequate Quality Requirements	Frequency	Percent
Strongly Disagree	2	5.4
Disagree	7	18.9
Neutral	9	24.3
Agree	9	24.3
Strongly Agree	10	27.0
Total	37	100.0
Mean 3.486		
S.D. 1.239		

reporting, 37.8% expressed that raw materials were not at the highest quality level, while 21.6% were neutral and 40.5% agreed or strongly agreed. In Table 16, 24.3% of the respondents reported that vendors are not provided with adequate data on quality requirements, while 24.3% were neutral and more than half (51.3%) either agreed or strongly agreed. Products that are supplied by vendors should be evaluated periodically and records maintained on their quality capabilities. Of the respondents reporting, 27% did not maintain records or evaluate vendors, while 18.9% were neutral and 54% agreed that they evaluated vendors as indicated in Table 17.

Almost two-thirds (64.8%) of the respondents felt their company does establish a close relationship with vendors as reflected in Table 18. Table 19 depicts whether the purchasing department require vendors to submit quality reports on purchased products. Almost one-third (32.4%) did not require vendors to submit quality reports, 24.3% were neutral and 43.2% required quality reports to be submitted by vendors. When the respondents were asked whether quality engineers make visits to the vendor facilities to assist in establishing quality procedures, 43.2% of the companies did not make visits, 18.9% were neutral, while 37.8% made visits periodically as reflected in Table 20.

Manufacturing

An examination of Table 21 reflects that twenty-one (56.8%) of the companies responding have implemented statistical process control while sixteen (43.2%) have not implemented statistical process control. In Table 22-26, respondents were asked the type of

Table 17. Products Supplied by Vendors are Evaluated Periodically and Records Maintained on Their Quality Capabilities

Vendor Quality Capabilities	Frequency	Percent
Strongly Disagree	2	5.4
Disagree	8	21.6
Neutral	7	18.9
Agree	7	18.9
Strongly Agree	13	35.1
Total	37	100.0
Mean 3.568		
S.D. 1.324		

Table 18. The Purchasing Department Establishes Close Communications with the Vendors

Communication with Vendors	Frequency	Percent
Strongly Disagree	1	2.7
Disagree	4	10.8
Neutral	8	21.6
Agree	13	35.1
Strongly Agree	11	29.7
Total	37	100.0
Mean		
S.D.		

Table 19. The Purchasing Department Requires Vendors to Submit Quality Reports on Products Purchased

Report on Products Purchased	Frequency	Percent
Strongly Disagree	6	16.2
Disagree	6	16.2
Neutral	9	24.3
Agree	10	27.0
Strongly Agree	6	16.2
Total	37	100.0
Mean 3.108		
S.D. 1.329		

Table 20. Quality Engineers Make Visits Periodically to the Vendors Facilities to Assist in Establishing Quality Procedures

Establishing Quality Procedures	Frequency	Percent
Strongly Disagree	9	24.3
Disagree	7	18.9
Neutral	7	18.9
Agree	6	16.2
Strongly Agree	8	21.6
Total	37	100.0
Mean 2.919		
S.D. 1.498		

Table 21. The Company Has Implemented Statistical Process Control Techniques

Implementation of Techniques	Frequency	Percent
Yes	21	56.8
No	16	43.2
Total	37	100.0
Mean 1.432		
S.D. .502		

Table 22. Product Conformance is Maintained Through Statistical Process Control by Operators

Conformance Maintained	Frequency	Percent
Yes	19	51.4
No	18	48.6
Total	37	100.0
Mean 1.432		
S.D. .502		

Table 23. Product Conformance is Maintained Through Statistical Process Control by Inspectors

Conformance Maintained	Frequency	Percent
Yes	18	48.6
No	19	51.4
Total	37	100.0
Mean 1.514		
S.D. .507		

Table 24. Product Conformance is Maintained Through Audits by Inspectors

Audit by Inspectors	Frequency	Percent
Yes	24	64.9
No	13	35.1
Total	37	100.0
Mean 1.351		
S.D. .484		

Table 25. Product Conformance is Maintained Through Audits by Quality Control Personnel

Audit by Quality Control	Frequency	Percent
Yes	25	67.6
No	12	32.4
Total	37	100.0
Mean 1.324		
S.D. .475		

Table 26. Product Conformance is Maintained Through 100% Inspection by Operators

100% Inspection	Frequency	Percent
Yes	23	62.2
No	14	37.8
Total	37	100.0
Mean 1.378		
S.D. .492		

procedure(s) used to maintain product conformance. As indicated in Table 22, 51.4% of the companies used statistical process control by operators, while 48.6% used statistical process control by inspectors as reflected in Table 23. In Table 24, almost two-thirds (64.9%) of the companies used audits by inspectors, 67.6% used audits by the quality control department (Table 25) and 62.2% used 100% inspection by the operator.

As reflected in Table 27, 41.77% of the companies did not perform process capabilities studies on equipment, while 13.9% were neutral and 44.5% did perform capability studies. More than half (52.8%) of the companies did not require operators to complete a training program. While 25% were neutral, only 22.2% required operators to complete a training program as reflected in Table 28.

Table 29 reflects whether the final assembly is tested prior to being shipped. Only 8.3% reported they did not test the final product while 16.7% were neutral and 75% did test the final assembly. In 62.9% of the companies, the first piece must be approved before the job is allowed to run as reflected in Table 30.

Table 31 indicates 38.8% of the companies responding do not have a formal training program to orient supervisors to the quality program. Twenty-five percent responded neutral, while 36.1% oriented supervisors to the quality program. On the other hand, 44.4% of the respondents did not have programs to train operators or supervisors in statistical process control, while 8.3% were neutral and 47.2% did train their operators and supervisors as reflected in Table 32. Table

Table 27. Process Capability Studies are Performed Periodically on Equipment

Capability Studies	Frequency	Percent	Adjusted Percent[a]
Strongly Disagree	5	13.5	13.9
Disagree	10	27.0	27.8
Neutral	5	13.5	13.9
Agree	10	27.0	27.8
Strongly Agree	6	16.2	16.7
No Response	1	2.7	—
Total	37	100.0	100.0
Mean 3.056			
S.D. 1.351			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 28. All Operators Must Complete an Extensive Training Program Prior to Operating Equipment

Capability Studies	Frequency	Percent	Adjusted Percent[a]
Strongly Disagree	11	29.7	30.6
Disagree	8	21.6	22.2
Neutral	9	24.3	25.0
Agree	4	10.8	11.1
Strongly Agree	4	10.8	11.1
No Response	1	2.7	--
Total	37	100.0	100.0
Mean 2.500			
S.D. 1.342			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 29. The Final Assembly is Tested for Performance Prior to Being Shipped to the Customer

Test Final Assembly	Frequency	Percent	Adjusted Percent[a]
Strongly Disagree	0	0.0	0.0
Disagree	3	8.1	8.3
Neutral	6	16.2	16.7
Agree	9	24.3	25.0
Strongly Agree	18	48.6	50.0
No Response	1	2.7	--
Total	37	100.0	100.0
Mean 4.167			
S.D. 1.000			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 30. For any New Setup, the First Piece Produced Must be Approved by an Inspector Before the Job is Allowed to Run

First Piece Inspection	Frequency	Percent	Adjusted Percent[a]
Strongly Disagree	6	16.2	17.1
Disagree	2	5.4	5.7
Neutral	5	13.5	14.3
Agree	5	13.5	14.3
Strongly Agree	17	45.9	48.6
No Response	2	5.4	--
Total	37	100.0	100.0
Mean 3.714			
S.D. 1.545			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 31. There is a Formal Training Program to Orient Supervisors to the Quality Program and Their Responsibilities in the Program

Formal Training	Frequency	Percent	Adjusted Percent[a]
Strongly Disagree	7	18.9	19.4
Disagree	7	18.9	19.4
Neutral	9	24.3	25.0
Agree	7	18.9	19.4
Strongly Agree	6	16.2	16.7
No Response	1	2.7	--
Total	37	100.0	100.0
Mean 2.944			
S.D. 1.372			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 32. There are Programs Setup to Train Operators, Supervisors, and Technical Employees in Statistical Process Control (SPC)

SPC Training	Frequency	Percent	Adjusted Percent[a]
Strongly Disagree	12	32.4	33.3
Disagree	4	10.8	11.1
Neutral	3	8.1	8.3
Agree	5	13.5	13.9
Strongly Agree	12	32.4	33.3
No Response	1	2.7	—
Total	37	100.0	100.0
Mean 3.714			
S.D. 1.545			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

33 indicated whether new employees are oriented and trained in the quality program. Of the companies responding, 43.2% did not train new employees, while 16.2% were neutral and 40.5% did train new employees.

There should be continuous feedback from manufacturing personnel concerning any problems with a new design. As indicated in Table 34, 10.8% were not concerned with feedback while over three-quarters (75.6%) did have continuous feedback concerning design problems. Twenty-seven percent of the respondents reporting did not inspect incoming material, while 16.2% were neutral and over one-half (56.7%) always inspected incoming material (Table 35).

In Tables 36-40, data reported reflect the percent of quality problems in companies related to unskilled operators, defective raw materials, inadequate methods, incapable processes, and environmental factors. The percentage of quality problems for each category is indicated in Tables 36-40 as well as the frequencies (number of companies).

In Table 41, respondents were asked to indicate what percent of operator's time is devoted to solving quality related problems. Twenty-eight (87.6%) of the companies responding indicated a range from zero (0) to ten (10) percent of the operator's time is devoted to problem solving, while four (12%) of the companies reported a range of fifteen (15) to seventy (70) percent. In Table 42, respondents were asked the percent of products scrapped at their company. The percent ranged from one (1) to twenty (20) percent with fourteen (37.8%) of

Table 33. All New Employees are Oriented and Trained in the Quality Program

New Employee Training	Frequency	Percent
Strongly Disagree	11	29.7
Disagree	5	13.5
Neutral	6	16.2
Agree	6	16.2
Strongly Agree	9	24.3
Total	37	100.0
Mean 2.919		
S.D. 1.588		

Table 34. There is Continuous Feedback from Manufacturing Concerning any Problems with the New Design

Continuous Feedback	Frequency	Percent
Strongly Disagree	0	0.0
Disagree	4	10.8
Neutral	5	13.5
Agree	14	37.8
Strongly Agree	14	37.8
Total	37	100.0
Mean 4.027		
S.D. .986		

Table 35. The First Lots of In-coming Material is Always Inspected and Tested to Determine if the Material Meet Plant Quality Specifications

New Employee Training	Frequency	Percent
Strongly Disagree	4	10.8
Disagree	6	16.2
Neutral	6	16.2
Agree	6	16.2
Strongly Agree	15	40.5
Total	37	100.0
Mean 3.595		
S.D. 1.443		

Table 36. What Percent of the Quality Problems Can You Attribute to Unskilled Workers

Percent of Quality Problems	Frequency	Percent	Adjusted Percent[a]
3	2	5.4	6.3
5	2	5.4	6.3
7	1	2.7	3.1
8	2	5.4	6.3
10	2	5.4	6.3
11	1	2.7	3.1
15	4	10.8	12.5
20	4	10.8	12.5
25	3	8.1	9.4
30	1	2.7	3.1
40	6	16.2	18.8
50	3	8.1	9.4
65	1	2.7	3.1
No Response	5	13.5	--
Total	37	100.0	100.0

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 37. What Percent of the Quality Problems Can You Attribute to Defective Raw Materials

Percent of Quality Problems	Frequency	Percent	Adjusted Percent[a]
1	2	5.4	6.1
5	4	10.8	12.1
10	11	29.7	33.3
19	1	2.7	3.0
20	4	10.8	12.1
25	2	5.4	6.1
30	2	5.4	6.1
35	2	5.4	6.1
40	3	8.1	9.1
50	1	2.7	3.0
80	1	2.7	3.0
No Response	4	10.8	—
Total	37	100.0	100.0

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 38. What Percent of the Quality Problems Can You Attribute to Inadequate Methods

Percent of Quality Problems	Frequency	Percent	Adjusted Percent[a]
2	1	2.7	3.1
4	1	2.7	3.1
5	1	2.7	3.1
10	6	16.2	18.8
12	1	2.7	3.1
15	2	5.4	6.3
20	7	18.9	21.9
25	3	8.1	9.4
30	5	13.5	15.6
35	1	2.7	3.1
40	3	8.1	9.4
70	1	2.7	3.1
No Response	5	13.5	--
Total	37	100.0	100.0

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 39. What Percent of the Quality Problems Can You Attribute to an Incapable Process

Percent of Quality Problems	Frequency	Percent	Adjusted Percent[a]
1	1	2.7	3.1
2	2	5.4	6.3
3	1	2.7	3.1
5	6	16.2	18.8
8	1	2.7	3.1
10	3	8.1	9.4
18	1	2.7	3.1
20	4	10.8	12.5
25	2	5.4	6.3
30	4	10.8	12.5
35	1	2.7	3.1
40	2	5.4	6.3
50	3	8.1	9.4
98	1	2.7	3.1
No Response	5	13.5	--
Total	37	100.0	100.0

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 40. What Percent of the Quality Problems Can You Attribute to Environmental Factors

Percent of Quality Problems	Frequency	Percent	Adjusted Percent[a]
0	1	2.7	5.3
2	6	16.2	31.6
3	1	2.7	5.3
5	6	16.2	31.6
10	3	8.1	15.8
25	1	2.7	5.3
39	1	2.7	5.3
No Response	18	48.6	--
Total	37	100.0	100.0

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 41. What Percent of the Operator's Time is Devoted to Solving Quality Related Problems

Percent of Quality Problems	Frequency	Percent	Adjusted Percent[a]
1	3	8.1	9.4
2	2	5.4	6.3
5	15	40.5	46.9
9	1	2.7	3.1
10	7	18.9	21.9
15	1	2.7	3.1
20	1	2.7	3.1
25	1	2.7	3.1
70	1	2.7	3.1
No Response	5	13.5	—
Total	37	100.0	100.0

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 42. What Percent of the Products at Your Facilities are Scrapped

Percent of Quality Problems	Frequency	Percent	Adjusted Percent[a]
1	14	37.8	40.0
2	4	10.8	11.4
3	7	18.9	20.0
4	2	5.4	5.7
5	4	10.8	11.4
9	1	2.7	2.9
10	2	5.4	5.7
20	1	2.7	2.9
No Response	2	5.4	--
Total	37	100.0	100.0

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

the companies reporting a one (1%) scrap rate, four (10.8%) reporting a two (2%) and seven (18.9%). As reflected in Table 43, the respondents indicated the percent of product reworked at their facility.

To determine whether companies used surveys and distributed them to their employees for feedback on the progress of the quality system, 18.9% of the companies did use surveys, while 73% did not and 8.1% used other methods (Table 44). When respondents were asked if they had a procedure to receive feedback from customers on the performance of their product, 91.9% of the companies had procedures, while only 8.1% of the companies had no procedure for feedback, as reflected in Table 45.

In Table 46, respondents were asked if they used procedures to determine quality cost. Almost half (48.6%) did not have any procedures, while 18.9% were neutral and 32.4% did implement procedures. An examination of Table 47 indicates that 29.7% of the companies did not review their quality system periodically, 18.9% were neutral and 51.3% had a review periodically to determine if the quality plans are being fulfilled.

Table 48 reflects whether the companies responding used procedures to measure and report quality data to all departments. Twenty-seven either strongly disagreed or disagreed, 21.6% were neutral, while 51.3% agreed or strongly agreed. In Table 49, companies were asked whether they used procedures to analyze and report customer's attitude on product quality and reliability. While

Table 43. What Percent of the Products at Your Facilities are Reworked

Percent of Quality Problems	Frequency	Percent	Adjusted Percent[a]
1	5	13.5	14.3
2	6	16.2	17.1
3	3	8.1	8.6
4	1	2.7	2.9
5	6	16.2	17.1
6	1	2.7	2.9
8	1	2.7	2.8
9	1	2.7	2.8
10	4	10.8	11.8
13	1	2.7	2.9
20	3	8.1	8.6
65	1	2.7	2.9
No Response	2	5.4	--
Total	37	100.0	100.0

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 44. Are Surveys Distributed Periodically to employees for Feedback on the Progress of the Quality System

Surveys for Feedback	Frequency	Percent
Yes	7	18.9
No	27	73.0
Other	3	8.1
Total	37	100.0
Mean 1.892		
S.D. .516		

Table 45. Is There a Procedure to Receive Feedback from Customers Pertaining to the Performance of the Product

Customer Feedback	Frequency	Percent
Yes	34	91.9
No	3	8.1
Total	37	100.0
Mean 1.081		
S.D. .277		

Table 46. To Determine the Cost Effectiveness of the Quality System, Procedures are Implemented to Analyze Quality Cost

Analyze Quality Cost	Frequency	Percent
Strongly Disagree	8	21.6
Disagree	10	27.0
Neutral	7	18.9
Agree	4	10.8
Strongly Agree	8	21.6
Total	37	100.0
Mean 2.838		
S.D. 1.463		

Table 47. Quality Procedures are Reviewed Periodically to determine the Quality Plans are Being Fulfilled

Review Quality Procedure	Frequency	Percent
Strongly Disagree	4	10.8
Disagree	7	18.9
Neutral	7	18.9
Agree	8	21.6
Strongly Agree	11	29.7
Total	37	100.0
Mean 3.405		
S.D. 1.384		

Table 48. There are Procedures to Measure and Report Quality Data

All Departments

Report Quality Data	Frequency	Percent
Strongly Disagree	3	8.1
Disagree	7	18.9
Neutral	8	21.6
Agree	8	21.6
Strongly Agree	11	29.7
Total	37	100.0
Mean 3.459		
S.D. 1.325		

Table 49. There are Procedures to Analyze and Report Customer's Attitude on Product Quality and Reliability

Report Customer's Attitude	Frequency	Percent	Adjusted Percent[a]
Strongly Disagree	4	10.8	11.1
Disagree	4	10.8	11.1
Neutral	7	18.9	19.4
Agree	9	24.3	35.0
Strongly Agree	12	32.4	33.3
No Response	1	2.7	—
Total	37	100.0	100.0
Mean 3.730			
S.D. 1.610			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

22.2% did not have any such procedures, 19.4% of the respondents were neutral and 58.3% did have procedures to analyze and report customer's attitudes.

In Table 50, companies were asked if they are aware of the Iowa State University -- Industry Affiliate program for productivity, quality, and reliability. Of the responses reporting, 24.3% were familiar with the program, while 75.7% were not. Table 51 reflects whether or not companies use any software in their quality control program. Almost two-thirds (62.2%) did use software, while 37.8% did not use software, after which respondents were asked to list the type of software or hardware (refer to Appendix B for results).

Table 52 indicates whether the company does have programs to train employees that are indirectly involved in the quality program. Over half (55.6%) do train employees indirectly involved in the quality program while 44.4% do not. Tables 53-55 reflect whether companies would be interested in obtaining additional knowledge pertaining to the implementation of statistical process control, uses of statistical process control data, or procedures for total quality control. Of the companies responding 56.5% indicated they would be interested in obtaining additional knowledge pertaining to the implementation of statistical process control as well as uses of statistical process control data, while 43.5% of the companies were not interested. Over ninety percent (91.3%) of the companies were interested in obtaining knowledge pertaining to the procedures of total quality control while only 8.7% were uninterested.

Table 50. Are You Aware of the Iowa State University--Industry Affiliate Program for Productivity, Quality, and Reliability

ISU-Industry Program	Frequency	Percent
Yes	9	24.3
No	28	75.7
Total	37	100.0
Mean 1.757		
S.D. .435		

Table 51. Does Your Company Use Any Software in the Quality Control Program

Quality Control Program[a]	Frequency	Percent
Yes	23	62.2
No	14	37.8
Total	37	100.0
Mean 1.378		
S.D. .492		

[a]If yes, please list the name of the software (refer to Appendix B). If yes, please list the name of the hardware (refer to Appendix B). If no, have you investigated any software (refer to Appendix B).

Table 52. There are Programs Setup to Train Employees That Are Indirectly Involved in the Quality Program

Train Employees	Frequency	Percent	Adjusted Percent[a]
Yes	20	54.1	55.6
No	16	43.2	44.4
No Response	2	2.7	--
Total	37	100.0	100.0
Mean 1.444			
S.D. .504			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 53. Would Employees at Your Company be Interested in Obtaining Additional Knowledge Pertaining to the Implementation of Statistical Procedure Control (SPC)

Implement SPC	Frequency	Percent	Adjusted Percent[a]
Yes	13	35.1	56.5
No	10	27.0	43.5
No Response	14	37.8	—
Total	37	100.0	100.0
Mean			
S.D.			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 54. Would Employees at Your Company be Interested in Obtaining Additional Knowledge Pertaining to the Uses of Statistical Procedure Control (SPC) Data

Use of SPC Data	Frequency	Percent	Adjusted Percent[a]
Yes	13	35.1	56.5
No	10	27.0	43.5
No Response	14	37.8	--
Total	37	100.0	100.0
Mean			
S.D.			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 55. Would Employees at Your Company be Interested in Obtaining Knowledge Pertaining to Total Quality Control

Use of SPC Data	Frequency	Percent	Adjusted Percent[a]
Yes	21	56.8	91.3
No	2	5.4	8.7
No Response	14	37.8	—
Total	37	100.0	100.0
Mean			
S.D.			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Research Questions

Question 1

To what extent does top management participate in the implementation of quality improvement programs?

Tables 1-6 provide information concerning management participation in the implementation of quality improvement programs. The results reflect that companies have a favorable opinion that top management does participate in establishing procedures for total quality control. Results revealed that 64.8% of the companies indicated that management does establish procedures for reporting quality cost. Further results reveal 67.5% agreed that management does establish a system to measure the outgoing quality level and 51.3% indicated that management does establish quality improvement goals. On the other hand, only 43.2% agreed that procedures are established to integrate all individuals in the quality control program as reflected in Table 5.

Question 2

What predominant methods are used to determine the quality problems that exist and the corrective action to resolve these problems?

It was reported in Table 17 that more than half (54%) indicated they evaluated vendors quality capabilities periodically. Seventy-five (75%) of the companies tested their product before it is shipped to the customer. Over seventy-five (75%) percent of the companies

have some form of feedback to inform design departments of any problems encountered during manufacturing due to poor design. Further results reveal that 56.7% of the companies inspect and test in-coming lots to determine if the material meets plant specifications.

Question 3

What particular methods or procedures are used to evaluate and maintain product conformance?

Results reported in Table 7 indicated that 56.7% of the companies perform quality research. This research reflects the quality characteristics and technical specifications the customer requires. Table 8 reveals that 45% of the companies do not use a checklist during the design phase of a new product, while 59% used either formal or informal meetings to review the design with quality and manufacturing personnel. Further results revealed that 51.3% of the companies perform reliability studies. Fifty (50) percent of the companies indicated their design department participates in the selection of vendors as well as assists in establishing the type of inspection required during production.

In 56.5% of the companies, the design department assists in working out any new methods and determining the desired tooling for production. In over sixty (60.9) percent of the companies, the design department assists in determining the desired equipment for production.

Question 4

Are specific programs set up to train and inform supervisors and employees of their responsibilities in the quality improvement program?

Results revealed that only 36.1% of the companies have training programs to orient supervisor to the quality program. Table 32 revealed that 44.4% of the respondents do not have a program to train employees in statistical process control, while 47.2% do have a training program. New employees are oriented and trained in the quality program in 40.5% of the companies, while 43.2% of the companies have no training for new employees. Over fifty (55.6) percent of the respondents train employees who are indirectly involved in the quality program, whereas 44.4% do not.

Question 5

What evaluations or procedures are used most frequently to determine the overall performance of the quality improvement system?

Results revealed only 18.9 of the companies used surveys to determine if the quality program was progressing while 73% did not use surveys. On the other hand, 91.9% of the companies responding had procedures to receive feedback from customer's pertaining to the performance of the product.

Further results revealed only 32.4% had procedures to determine quality cost or the cost effectiveness of the quality system, whereas 51.3% of the companies reviewed their quality plans periodically. Over fifty (51.3) percent of the companies used procedures to measure

and report quality data to all departments and 58.3% have procedures to analyze and report customer's attitudes on product quality and reliability.

Summary of Findings

The results of the analysis covered four basic areas: 1) management, design, purchasing, and manufacturing. Findings conveyed that management does participate in the implementation of quality improvement programs. Over two-thirds of the companies responded that management does establish procedures for reporting quality cost as well as a system to measure true outgoing quality. Over half (51.3%) of the respondents indicated that management does establish quality improvement goals, although only 43.2% agreed management does establish procedures to integrate each employee in the quality program.

The findings indicated that the design department in 37.8 percent of the companies have procedures to evaluate each phase of the design process as well as the selection of vendors. There is very little participation from the design department in establishing the type of inspection required (16.6%). However, the design department does participate in working out new methods and determining the desired tooling in 56.5% of the companies responding, while only 39.1% participate in the selection of equipment.

The purchasing department 64.8% of the companies establish close communication with vendors. In approximately fifty percent of the companies responding participants reported that vendors are provided

with data on quality requirements, evaluated periodically on their quality capabilities and require reports to the submitted on products purchased.

Many of the companies do have procedures to maintain product conformance. Over fifty (56.5) percent of the companies have implemented statistical process control. Results are evenly distributed on whether companies use process capability studies on equipment.

CHAPTER V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The previous chapters of this research dealt with the introduction, background, methodology, analysis, and findings of the research. The purpose of the chapter is to summarize the preceding chapters, draw conclusions based on the findings, and present recommendations for further research.

Summary and Conclusions

This section provides a summary and the conclusions of the study, which are presented in relation to each research question. The five research questions are restated followed by a brief discussion of the findings.

Restatement of the problem

Most manufacturing industries employ some form of quality program, but do such programs have an organization wide impact? This study is designed to investigate the type of quality programs and methods that Iowa manufacturing industries employ.

Restatement of purpose

This study is designed to investigate if quality programs in Iowa manufacturing industries have an organization wide impact, from top management to hourly employees.

Research Question 1

To what extent does top management participate in the implementation of quality improvement programs?

Discussion Based on results reported in Table 1-4, it is concluded that management does participate in establishing procedures for the quality improvement program.

Research Question 2

What predominant methods are used to determine the quality problems that exist and the corrective action to resolve these problems?

Discussion Results found in Table 17 indicate that 54% of the companies have procedures to evaluate their vendors' quality capabilities periodically. The majority of the companies (75%) reported that the final assembly is tested prior to shipment as well as the fact that they use methods to provide feedback from manufacturing to the design department concerning problems. On the other hand, results indicate in Table 35 that most companies (56.7%) inspect in-coming material and very little operator's time is devoted to resolving quality related problems. It is concluded that companies do have methods to determine what quality problems exist.

Research Question 3

What particular methods or procedures are used to evaluate and maintain product conformance?

Discussion Results indicate 56.7% of the companies perform quality research to determine customer requirements during design. However, results in Tables 8-11 indicate companies are more actively

involved in preventing product nonconformance than others through the use of checklist (37.8%), formal/informal meetings (54%), tolerance analysis (35.1%), and reliabilities studies (51.3%) during the design process.

Most companies maintain a close relationship with vendors as well as provide vendors with data on company quality requirements (Tables 16 and 18). Results in Table 17 indicate 54% of the companies do evaluate vendor quality capabilities periodically, however less than half (43.2% and 37.8%, respectively) require vendors to submit quality reports on products purchased or make visits periodically to the vendors facilities to assist in establishing quality procedures as reflected in Tables 19 and 20.

Over fifty percent (56.8%) of the companies have implemented statistical process control. Even though the companies maintain product conformance during manufacturing either through SPC by operators (51.4%) or inspectors (48.6%), most companies still use audits by inspectors (64.9%), quality control personnel (67.6%) in 62.2 percent of the companies and 62.2 percent use 100% inspection (Tables 22-26). Results found in Table 27 to determine if process capability studies are performed were evenly distributed. Only 22.2% of the companies have a training program for new operators. Therefore, it is concluded that companies evaluate and maintain product conformance through quality research, statistical process control, audits by inspectors, quality control personnel, and 100% inspection.

Research Question 4

Are specific programs set up to train and inform supervisors and employees of their responsibilities in the quality improvement program?

Discussion Results in Table 31 indicate that only 36.1 percent of the companies have a formal training program to orient supervisors to the quality program. Less than half (47.2%) of the companies train operators, supervisors, and technical employees in statistical process control (Table 32). In 40.5 percent of the companies, all new employees are oriented and trained in the quality program (Table 33), while 55.6 percent train employees that are indirectly involved in the quality program (Table 52). Therefore, it is concluded that most companies do not have programs set up to train employees directly involved in the quality system.

Research Question 5

What evaluations or procedures are used most frequently to determine the overall performance of the quality improvement system?

Discussion As indicated in Tables 44 and 45, 73% of the companies do not distribute surveys for feedback on the progress of the quality system, whereas 91.9% do have procedures to receive feedback from customers on the performance of the product. Over fifty (51.3) percent of the companies do evaluate and determine if their quality plans are being fulfilled and report quality information to all departments. Over fifty (58.3) percent of the companies have

procedures to report customers' attitude on product quality and reliability. Therefore, it is concluded that more companies evaluate the performance of their quality system than those who do not.

Recommendations

This section of the chapter contains recommendations for future research. Based on the findings of the study, the following recommendations were made:

1. It is recommended this study be duplicated after a period of time to determine if there is any progress in the companies' quality programs.
2. Further research be conducted to assess barriers encountered that restrict companies from implementing total quality control programs.
3. It is recommended that this study be duplicated in a different geographical region as a comparative study.

It is the author's opinion in this research that:

1. Companies in Iowa are interested in implementing procedures to enhance their quality programs, but do not have the resources or totally understand the benefits. Although companies have quality programs, many do not have a total quality control program.
2. Some companies would welcome projects by Iowa State University to become acquainted with total quality control procedures.

It is my hope that this research and information will provide the

basis for conducting further research on quality programs in Iowa industries.

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APPENDIX A. LETTER AND QUESTIONNAIRE

College of Education
Department of Industrial
Education and Technology
Ames, Iowa 50011

IOWA STATE
UNIVERSITY

Telephone: 515-294-1033

February 15, 1988

Presently I am attending Iowa State University, where I am pursuing a Master of Science in Industrial Technology. Enclosed is a questionnaire which is designed to identify and compare the type of quality control programs Iowa manufacturing industries employ. Realizing how busy you are the questionnaire is brief and should take approximately fifteen minutes to complete.

The purpose of the questionnaire is to provide information which can be used to improve quality programs as well as prepare students for future employment. Please complete the enclosed questionnaire by March 7 and return it in the enclosed postage paid envelope. This information is being gathered for statistical purposes only and will be kept confidential.

If you have any questions regarding this research, please feel free to call me at (515) 294-7350. To ensure the inclusion of your responses, please return the questionnaire as soon as possible. A copy of the results will be available upon request.

Again, thank you for your assistance and cooperation.

Sincerely,

Jeffrey Beamon

Jeffrey Beamon

Dr. William D. Wolansky
(Professor in Charge of Study)
College of Education
Iowa State University

Code No. _____

INSTRUCTIONS: Please answer the following questions or statements by placing your response in the space provided or circle your response where applicable. Please respond to the questions and statements as they apply to your company.

I) MANAGEMENT

1. Top management establish procedures for accumulating, compiling and reporting quality cost.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

2. Top management establish quality cost reduction programs and goals.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

3. Top management establish systems for measuring the true outgoing quality level of the product.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

4. Top management establishes product quality improvement goals and programs by product line.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

5. Top management establish procedures to integrate all individuals in the quality control organization.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

6. Top management establish measures to determine the contribution of the quality control function to profitability and progress of the company.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

II) DESIGN

7. Quality research is performed to determine quality characteristics such as customer requirements and technical specifications.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

8. A checklist is used to review each phase of the design process.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

9. There are formal informal meetings held periodically to review product and design specifications with the quality department and manufacturing engineering.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

10. A tolerance analysis is performed on all new devices before they are placed in production.

    Strongly Disagree 1 2 3 4 5 Strongly Agree

11. Reliability studies are performed to determine what performance can be guaranteed.

    Strongly Disagree 1 2 3 4 5 Strongly Agree

12. The design department participates in the selection of vendors for raw materials.

    Strongly Disagree 1 2 3 4 5 Strongly Agree

13. The design department establishes the type of inspection required during actual production.

    Strongly Disagree 1 2 3 4 5 Strongly Agree

14. Which of the following does the design department become involved with? Please check the ones that apply.

    _____ Working out any new methods
    _____ Determing the desired tooling for production
    _____ Determing the desired equipment for production

III) PURCHASING

15. In-coming materials are always at the highest quality level expected by your company.

    Strongly Disagree 1 2 3 4 5 Strongly Agree

16. The vendors are provided with adequate data on quality requirements by the purchaser.

    Strongly Disagree 1 2 3 4 5 Strongly Agree

17. Products supplied by vendors are evaluated periodically ands records maintained on their quality capabilities.

    Strongly Disagree 1 2 3 4 5 Strongly Agree

18. The purchasing department establishes close communications with the vendors.

    Strongly Disagree 1 2 3 4 5 Strongly Agree

19. The purchasing department require vendors to submit quality reports on products purchased.

Strongly Disagree 1 2 3 4 5 Strongly Agree

20. Quality Engineers make visits periodically to the vendors facilities to assist in establishing quality procedures.

Strongly Disagree 1 2 3 4 5 Strongly Agree

IV) MANUFACTURING

21. Has your company implemented statistical process control(SPC) techniques?

_____ Yes
_____ No

22. Please check the type of procedure used to maintain product conformance at your facilities.

_____ SPC, performed by operators
_____ SPC, performed by inspectors
_____ Audits by inspectors
_____ Audits by QC personnel
_____ 100% inspection by operators
_____ If other, please specify _____

23. Process capability studies are performed periodically on equipment.

Strongly Disagree 1 2 3 4 5 Strongly Agree

24. All operators must complete an extensive training program prior to operating equipment.

Strongly Disagree 1 2 3 4 5 Strongly Agree

25. The final assembly is tested for performance prior to being shipped to the customer.

Strongly Disagree 1 2 3 4 5 Strongly Agree

26. For any new setup, the first piece produced must be approved by an inspector before the job is allowed to run.

Strongly Disagree 1 2 3 4 5 Strongly Agree

27. There is a formal training program to orient supervisors to the quality program and their responsibilities in the program.

Strongly Disagree 1 2 3 4 5 Strongly Agree

28. There are programs setup to train operators, supervisors and technical employees in statistical process control.

Strongly Disagree 1 2 3 4 5 Strongly Agree

29. All new employees are oriented and trained in the quality program.

Strongly Disagree 1 2 3 4 5 Strongly Agree

30. There is continious feedback from manufacturing concerning any problems with the new design.

Strongly Disagree 1 2 3 4 5 Strongly Agree

31. The first lots of in-coming material is always inspected and tested to determine if the material meet plant quality specifications.

Strongly Disagree 1 2 3 4 5 Strongly Agree

32. What percent of quality problems can you attribute to:

a) Unskilled operators

____ %

b) Defective raw materials

____ %

c) Inadequate methods

____ %

d) Incapable process

____ %

e) Enviromental factors

____ %

33. What percent of operator's time is devoted to solving quality related problems?

____ %

34. What percent of the products at your facilities are scrapped?

____ %

35. What percent of the products at your facilities are reworked?

____ %

36. Are surveys distributed periodically to employees for feedback on the progress of the quality system?

_____ Yes
_____ No
_____ If other, please specify _____

37. Is there a procedure to receive feedback from customers pertaining to the performance of the product?

_____ Yes
_____ No
_____ If other, please specify _____

38. To determine the cost effectiveness of the quality system, procedures are implemented to analyze quality cost.

Strongly Disagree 1 2 3 4 5 Strongly Agree

39. Quality procedures are reviewed periodically to determine if the quality plans are being fulfilled.

Strongly Disagree 1 2 3 4 5 Strongly Agree

40. There are procedures to measure and report quality data to all departments.

Strongly Disagree 1 2 3 4 5 Strongly Agree

41. There are procedures to analyze and report customer's attitudes on product quality and reliability.

Strongly Disagree 1 2 3 4 5 Strongly Agree

42. Are you aware of the Iowa State University - Industry Affilliate Program for productivity, quality, and reliability?

___ Yes
___ No

43. Does your company use any software in the quality control program?

___ Yes
___ No

If yes, please list the name of the software.

If yes, please list the name of the hardware.

If no to question 43, then have you investigated any software.

44. Are there programs setup to train employees that are indirectly involved in the quality?

___ Yes
___ No

45. Would employees at your company be interested in obtaining additional knowledge pertaining to any of the following areas through seminars, workshops, etc. provided by Iowa State University? Please check the ones that apply.

___ Implementation of SPC
___ Uses of SPC data
___ Procedures for Total Quality Control
___ If other, please specify _____

APPENDIX B. DATA RESULTS FROM QUESTION #43

From Question 43.

If your company uses software in the quality control program, please list the name of the software:

Software	Frequency
Statgraphics	1
Lotus-Symphony, 1-2-3	2
SPC-PC	1
Crosby	1
In House Design	8
SPC-Pack	2
Proprietory Manucomy Corp.	1
SPC-Express	3
Microstat	1
SMIP (from Control Data)	1

If your company uses hardware in the quality control program, please list the name of the hardware

Hardware	Frequency
IBM PC, PS2	13
Panisonic	1
NEC	1
VAX System	3
Macintosh	1

If your company does not use software in the quality control program, then have you investigated any software

Investigated software	Frequency
Yes	1
No	5
Total	6

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